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CIRCULAR No. 19.

(Printed by order of the Legislature.)

**PROVINCE OF NOVA SCOTIA.
COLLEGE OF AGRICULTURE.**

TRURO, N. S., 1917.

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**THE BITING INSECT OF THE APPLE IN NOVA
SCOTIA.**

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THE BITING INSECT OF THE APPLE IN NOVA SCOTIA.

By G. E. Sanders, Field Officer in Charge, Dominion Entomological Laboratory, Annapolis Royal, N. S.

The biting insects of the apple in Nova Scotia, are really divided into three groups: (1) Those which cause serious loss each year in orchards not thoroughly sprayed, and which are not influenced to any great extent by parasites or other natural means of control; (2) those which are capable of doing very serious injury, but are periodically controlled and brought almost to extermination by their parasites and (3) those which are of secondary economic importance which may or may not be more or less controlled by parasites.

Permanent, Serious Pests.

In this first group are the budmoths, the fruit worms and the Codling Moth.

The Budmoths. At present four species of budmoth are known, which attack the apple in Nova Scotia. The Eye Spotted Budmoth, *Spilonota* (Tmetocera) *ocellana*, Schiff, is the most common, far outnumbering all the other species taken together. The next most common species is the Oblique Banded Leaf Roller, *Archips rosaceana*, Horr, which is found in greater or less numbers throughout the province, but only occasionally, in small localities, becoming a serious pest for a year or so, and then disappearing. The third species *Olethreutes consanguinana*, is distributed throughout the western end of the province, but has been found attacking apples only about Kentville, where in some orchards it is doing an immense amount of damage, apparently twenty-five per cent of the budmoth injury being done by this species. In the fiftieth Annual Report of the Fruit Growers Association of Nova Scotia, *Olethreutes consanguinana* was recorded for the first time by the author as feeding on the apple. It was then referred to as *O. frigidana*. The fourth species, the Lesser Budmoth, *Recurvaria nanella*, Hubn, is a native of Europe, which was last year recorded for the first time from Nova Scotia. The extent to which this insect damages the apple has not been accurately determined, nor has its distribution been carefully worked out but it has been taken from both ends of the Annapolis Valley. Being an imported insect, there is a possibility of it becoming a serious pest; already E. W. Scott and J. H. Payne in Bul. 113 of the U. S. Department of Agriculture

have recorded it as infesting 45 per cent of the buds in an apple orchard in Benton Harbor, Michigan. This insect will receive careful attention in Nova Scotia during the next few years.

General Life Histories.

All four of our species of budmoths have somewhat similar life histories. They all pass the winter as larvae in hibernating cocoons; they all emerge as the buds begin to swell in the spring, and bore into the opening tips; they all feed in the same manner until the blossoms open, usually under cover of a mass of dead and partly eaten leaves. The date of pupation varies, some pupating during, or immediately after, the blossoming period, some three or four weeks later. All pupate among the leaves on the trees. In all species the eggs are deposited on the leaves, *A. rosaceana* depositing its eggs in a mass, and others depositing them singly. In *R. nanella*, the young larva acts as a true leaf miner in the autumn; in *O. consanguinan* and *S. ocellana* the larvae act as semi-leafminers always feeding under cover, but where possible, tying two leaves together, or the leaf to a limb or an apple, often disfiguring the fruit by feeding on it. In *A. rosaceana*, the larvae feed on the leaf rather than in it. All species are single brooded in Nova Scotia, and leave the leaves on which they are feeding to form their winter hibernating cases with the first frosts, to pass the winter as partly grown larvae.

Extent of Injury.

Spring Injury. There has been much controversy in regard to the extent of the injury done by the budmoth entering the bud in the spring. The boring of a budmoth larva into a bud very seldom prevents blossoming. Actual counts show only 35 per cent of the blossoms in the infested clusters to be noticeably injured; the actual damage done, however, exceeds this. Counts on Wagener's in 1913 and 1915 show the set in blossom clusters infested, to be reduced 74.7 and 79.4 per cent respectively, so by counting the number of buds infested by budmoth in an orchard, and then reckoning that the percentage of reduction in crop will amount to about three quarters of that figure, one can estimate fairly accurately the amount of damage the budmoths are doing in an orchard.

Fall Injury. The damage that the budmoths do to the foliage in the fall is negligible, but the habit of two species in tying the leaf up to the apple and marring the surface,

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making it fit usually for a No. 3 or a cull, often causes serious loss. Usually for every ten per cent of the buds damaged by budmoth in the spring, three per cent of the picked fruit will be marred by the budmoth tying up the leaf to it and feeding off the surface of the fruit.

Extent of Damage in Nova Scotia.

The highest percentage of infestation recorded in the buds, in 1915, was in the Early Williams variety, 96.4 per cent of the buds in one plot being infested. The average infestation in unsprayed orchards for all varieties, runs about 40 per cent; in such an orchard about 12 per cent of the apples would have leaves tied to them.

Varieties which have crinkly twigs, such as Wagener, Ribston, Pippin, Nonpareil, Early Williams, etc., are most invariably more heavily infested than clean limbed varieties such as Golden Russet, N. Spy and Ben Davis. This is due to the crinkly twigged varieties offering better protection to the cocoon in which the half-grown larvae hibernate.

Controls.

It has for several years been recognized that the best time to spray for the control of the budmoth, is after the leaves open, and before the blossoms appear. The semi-dormant spray with lead arsenate, for some time recommended, has been proved almost worthless in budmoth control in the experiments conducted in R. S. Eaton's orchard in 1912-13, a spray applied about four days before the blossoms opened having given the best results in that experiment. In 1915, experiments were carried on in S. B. Chute's orchard to determine the value of the two sprays before blossoming, one when the leaves are the size of a ten cent piece and the other immediately before blossoming, as compared with one spray about four days before the blossoms opened. The results show that one spray five days before blossoming, followed by two after the blossoms fall, killed 51 per cent of the budmoths, which normally became adults, while the two sprays before blossoming killed 75 per cent.

In an experiment conducted in the George Hoyt orchard, Annapolis, to compare the new Friend Drive nozzle with the Friend Calyx nozzle in budmoth control, the two plots received four sprays, each with the same kind of spray, 2 lbs. paste lead arsenate, 1 gal. lime sulphur solution to

40 gallons. Where the Calyx nozzle, which throws a mist spray very similar to the "misty" and "whirlpool" nozzles, was used, 84 per cent of the budmoths which would otherwise reach maturity were killed. Where the Drive nozzle was used 94 per cent of the budmoths were killed.

The recommendations for budmoth control are, 5 to 7 lbs. arsenate of lead, or 2 lbs. arsenate of lime to 100 gals. of water, applied when the leaves are the size of a ten-cent piece, and again when the blossom buds, are showing pink with a drive nozzle, and immediately after the blossom falls, with either a "calyx" or "drive" nozzle. The spray two weeks after blossoming, has very little effect in budmoth control.

The Fruit Worms, or Apple Worms.

The fruit worms present in Nova Scotia probably number a dozen species, belonging to the *Xylina*, *Calocampa* and *Scoplosoma*. The life history, and damage done by each species is very similar. One species, *Xylina bethunei* G. and R. is the most common, far outnumbering all of the other species combined, and its life history is, in a general way, similar to that of all species of fruit worms so far studied in Nova Scotia.

Life History of X. bethunei.

The adult moth emerges in September and early October, flies until winter, hibernates in rubbish, in old fences, grass etc., and is one of the first moths to be found on the wing in the spring, usually being found flying early in April. About one month after its emergence in the spring, it begins depositing its eggs on the apple-tree. The eggs are deposited singly, about one inch from the tip, on the under side of the outer limbs. The period of the egg deposition covers the Month of May. Eighteen days after the egg is deposited the larva emerges and begins to feed on the leaves. The greatest number of larvae emerge about the time the Gravenstein buds begin to show pink. For the first three weeks of its existence, or until it is in the third instar, the larva feeds on leaves and blossoms. At the beginning of the third instar it forsakes leaves almost entirely and feeds on the fruit, eating holes in the sides of the young apples, usually biting into a new apple for each meal, so that a single larva may do an enormous amount of damage in one season. In all, the larvae moult five times and begin to pupate about July 12th. Pupation continues until about August 5th. For a week or so before pupation,

the larvae revert to their early feeding habits, eating as much, if not more, of the leaves than the fruit.

The pupa is formed in a very thin silken web, one or two inches below the surface of the earth. The pupal stage lasts about two months, the first adults emerging about September 15th.

General Description.

In general, the adults of the fruit worms are strong flying, somewhat sharp winged moths, from 1.25 to 1.5 inches across the extended wings. The eggs are conical, ribbed vertically, with a small depression on the top. The larvae are for the most part green in the early stages, sometimes faintly marked with white. In *X. bethunei*, the sixth stage larvae are slaty grey. In the Calocampids, the sixth stage larvae are heavily striped with brown; in some of the Xyliniids the final stage of the larvae is greenish white with white markings.

Injury.

The fruit worm larva during the first three weeks of its existence feeds on leaves and blossoms, eating proportionately more surface for a meal than later when it is feeding on the fruit. During this period the damage to the leaves is negligible, but the damage to the blossoms is quite extensive, as the young larvae have been observed eating the pistils, stamens and corolla, but owing to the number of false blossoms always present, the actual percentage of damage cannot be determined.

When apples are a little thicker than a lead pencil, the third stage larvae begin feeding on them, eating small regular holes in the sides, consuming a large quantity of inner pulp in proportion to the surface eaten. As a rule a fresh apple is eaten into for each meal. In cases where the fruit worm eats through the outer pulp, or what is technically known as the receptacles of the apples, and in to the core, serious malformation of the fruit usually results. In cases where the injury is confined to the outer pulp, the injury heals over to form a somewhat regular roughened area with very little, or no malformation. It has been found by actual count that 72 per cent of the apples eaten by the fruit worms in the spring, drop as a result of the injury; thus, roughly speaking, for every three apples found in picked fruit, showing fruit worm injury, seven have already dropped to the ground as a result of the injury. Of the picked fruit,

which was No. 1 and No. 2 in size and showed no defect excepting fruit worm injury, 78 per cent were thrown into No. 3's and culls, in an observation to determine the actual injury.

Distribution in Nova Scotia.

Although fruit worms vary slightly in number from year to year, they are, on the whole, fairly constant and evenly distributed in every locality in Nova Scotia where apples are grown. An observation carried on in one locality, with the idea of determining the amount of damage done in various orchards, showed the most sheltered orchard to have 8.2 of the picked fruit injured by fruit worms, while in the most exposed orchards, only eight tenths of one per cent of the picked fruit, showed fruit worm injury. Further observation showed that the percentage of fruit worms varied directly with the sheltered location of the orchard. This is no more than one would expect from studying the life history of the insects. They are very active, strong flying moths and are on the wing for a month and a half in the fall, and one month in the spring before they deposit their eggs, and one could hardly expect them to be as numerous in the exposed and wind swept orchards as in the more sheltered ones, where they would be blown in and would not afterwards be blown out.

Controls.

From following the life history of the fruit worm, it can easily be seen that the time to spray for it is when in its earliest stages, and when it is eating the greatest amount of surface in proportion to the amount of food consumed. Actual experiment proves this to be the case, and the two sprays, one immediately before the blossoms, and one immediately after, gave a reduction in injury of 65 per cent. The spray applied from two weeks to ten days after the blossoms, gave no reduction in injury for the year in which it was applied, but gave a slight reduction the following year, showing that it poisoned the fruit worm after it had done its damage for the year, probably when it was feeding on leaves just before entering the pupal stage.

Carnivorous Habits.

During the season of 1913, while collecting the larvae of *X. bethunei* in the field, it was found that the fifth and sixth stage larvae, ordinarily, when they find the

cocoons of the common Tent Caterpillars, *Malacosoma disstria* and *M. americana*, gnaw their way in through the cocoon and feed on the pupa contained. In 1913, 34.82 per cent of the *M. disstria* cocoons collected on apple, on July 12 and 13, were found to be destroyed by *X. bethunei*. In 1914, the cold weather retarded the Tent Caterpillars more than the Fruit Worms, which pupated at about the same time as the Tent Caterpillars, so only 5.99 per cent of the tents were destroyed by them in that season.

The Codling Moth.

The Codling Moth is not nearly so serious a pest in Nova Scotia orchards as it is in some localities which have a longer summer. Again, the high percentage of sprayed orchards has reduced the pest greatly even in orchards which have never been sprayed. In districts outside the Annapolis Valley, where thorough spraying is not practiced in any considerable number of orchards, occasionally thirty, forty or even fifty per cent of the apples may be found infested by codling moth, while in the Valley it is rare even to find an unsprayed orchard which will give over five per cent codling moth injury, while in well sprayed orchards it is not rare to count over two thousand apples and find only one of them wormy.

Life History.

The codling moth passes the winter as a full grown larva in a small cocoon concealed under the bark or in crevices about fruit houses. The pupa is formed in this cocoon in the spring and the first adult moth appears about the time the blossoms begin to open. The emergence of the adult is spread over a very large period in Nova Scotia, and as far as can be determined there is only one brood in the Province, but being spread over such a period we get all of the types of injury caused by the first and second broods elsewhere, and we also find the larvae controlled to a certain extent by all of the spring sprays.

The egg is deposited singly on either the leaf or the apple, and about the time the blossoms fall the young larvae begin to emerge. As a rule the larvae feed first on the leaf, and then proceed to the apple, boring in either from the blossom end or the side, so causing the familiar wormy apple.

During September and October, the larvae leave the apples and form their winter cocoons.

Controls.

The recognized control is of course arsenical sprays as recommended by the spray calendar. Experiments have shown that the spray applied immediately after the blossoms will destroy 89.2 per cent of the larvae, while the spray applied immediately before the blossoms controls 71.3 per cent and the spray two weeks after the blossoms controls 65.5 per cent. Where all three sprays were used 92.2 per cent were destroyed.

Periodic Pests.

In the second group we have three sets of leaf eating insects which are causing most noticeable damage where present, and while they very rarely, if ever, do as much damage in Nova Scotia in a single year as is caused by either the budmoths of the fruit worms, yet their presence causes more comment and suggestions in regard to insect legislation than is ever caused by the more injurious, but less noticeable budmoth.

This group in Nova Scotia consists of the canker worm, the tent caterpillar and the tussock moth.

The Canker Worm.

The canker worm in Nova Scotia presents a most interesting problem when considered from the viewpoint of natural outbreak or natural control. At no time during the past six years has the Annapolis Valley been free from canker worm outbreaks. It has been increasing in one locality and decreasing in another throughout the period. At the present time a number of orchards east of Wolfville are very seriously infested, a number of small infestations are running between Bridgetown and Middleton, and outside these two districts there are a few outbreaks, particularly two on oak, one at Bear River and one near Annapolis, making probably more canker worms in the Valley than there have been for years.

Life History.

The most common species in Nova Scotia is the fall canker worm, *Alsophila pometaria* Har. This species passes the winter in the egg stage, the eggs being deposited in regular flat clusters, one one hundred or more, on the branches of the apple, oak and other food plants. Three or four days before the apple blossoms open, the young

larvae emerge and begin feeding on the leaves. About the last of June they finish feeding and drop to the ground, burrowing about an inch down in the soil to pupate. About Nov. 1st the adults emerge. The males, small grey moths, may be seen flying about the trunks of the apple and oak trees; the females, small wingless gray slugs, at the same time may be crawling up the trunk of the trees to deposit their eggs on the branches.

Remedies.

The very best remedy, and one that is sure, is to band the trees about Oct. 25th, with a three inch band of tanglefoot. One pound of commercial tree tanglefoot will band about eight ordinary sized trees. Tree tanglefoot may be made at home by boiling together 9 lbs. of resin, 7 lbs. of castor oil and $\frac{1}{2}$ lb. of paraffin wax. If too soft, add more resin; if too hard add more oil.

Thorough spraying in the spring will control canker worm. To get the best results, the spray should be applied before the blossoms open, when the caterpillars are young. After the canker worm larva is one third grown, it is a very hard insect to kill and so the best results cannot be expected from spraying for them after the blossoms fall.

Tent Caterpillars.

There are two species of tent caterpillars, the forest tent, *Malacosoma disstria*, and the American or orchard tent, *M. americana*, in Nova Scotia. Both species feed on forest and shade trees as well as on the apple.

Life History.

Both species pass the winter in the egg stage, the eggs being deposited in rings about the small twigs of the tree. As soon as the first leaves appear the young caterpillars emerge and feed on the leaves as they grow. The forest tent has a row of white dots down the back, while the American tent has a white strip down the back. Both are hairy caterpillars. The American tent forms a large conspicuous web in the crotch of a tree, while the forest tent forms no noticeable web, but collects in large clusters on the trunk of the tree when not feeding. During June, they spin up cocoons and pupate among the leaves on the trees or in any other convenient place. In mid-July the adults emerge and deposit the eggs for next year's brood.

Remedies.

The best remedy for the tents is, through spraying with arsenicals when the leaves are about the size of a ten cent piece. Cutting off the branches bearing the webs, is often practiced, but it is more wasteful and less efficient than thorough spraying.

The Tussock Moth.

In 1907, the Annapolis Valley was visited by a very serious outbreak of Tussock Moth, which not only partially defoliated many orchards in mid-July, but by their nibbling at the fruit rendered worthless the majority of the apples in many orchards. In 1910 and 1911 another outbreak occurred which did an immense amount of damage to the shade trees of Halifax, but did very little damage to the Annapolis Valley. In 1915 a small amount of damage was done to a few orchards in the west end of the Valley and in 1916, this outbreak increasing, has rendered worthless from ten to twenty per cent of the crop of apples in many orchards. Next year, 1917, we may look for an immense amount of damage to be done by the tussock moth throughout the west end of the Valley and in some localities in the eastern end of the Valley.

The most common species in Nova Scotia is the White Marked Tussock Moth, *Hemerocampa leucostigma*.

Life History.

The winter is passed in the egg stage, an irregular cluster of eggs covered with white froth on a dead leaf among the branches. During the last week of June the larvae emerge and for the first two weeks of their existence they feed entirely on leaves, later feeding on leaves or apples, eating shallow irregular shannels in the apples, rendering them fit only for No. 3's or culls. The larvae may be identified with certainty by two pencils or brushes of black hairs projecting forward from each side of the head, and one projecting backwards from the hinder end of the body and by four short tufts of white hairs placed in a row on the back. In August the larva pupated in a loosely built cocoon in which one or more dead leaves are included among the fruit spurs. In September the adults emerge; the males, small brownish grey winged moths; the females, wingless slugs which deposit their eggs in a cluster on the old pupa case and dead leaves of the cocoon.

Remedies.

Hand picking of the egg masses when the trees are bare during the winter is more or less practicable, depending on the size of the tree and whether it is open or thick. The best remedy is to use an arsenical poison in the last summer spray, that is, the one applied during the last days of June or the first days of July. This will poison the larvae when they are still young and feeding on leaves entirely, and so is the most efficient remedy for them.

Less Important Insects of the Apple.

In this third group we have a number of insects which cause frequent inquiries but which are of slight importance, economically, to the apple industry as a whole.

The Yellow Necked Caterpillar.

Frequently in late summer a few limbs or young trees in an orchard will be found defoliated by a cluster of large greenish striped caterpillars. The yellow thoracic shield, looking like a yellow collar, and the habit of the larvae of pointing both ends of the body up, identify this as the yellow necked caterpillar, *Datana ministra*.

In bad infestations, spraying would prove practicable, but in six years' experience in Nova Scotia, only scattering isolated clusters have been found and by all odds the most economical treatment is to pick off and destroy them when found.

The Red Humped Caterpillar.

The Red-humped Caterpillar, *Schizura concinna*, is very similar to the last in almost every detail. The red humped caterpillar is about an inch long, spiny, reddish brown in color, with a red hump or saddle across the back. They are found occasionally in clusters, stripping single limbs, but never doing extensive damage. Like the yellow necks, they are pretty well controlled by their natural enemies, and where found in noticeable numbers, hand picking is the most efficient remedy.

The Fall Webworm.

The fall webworm, *Hyphantria cunea*, is found now very commonly in the pastures and orchards of Nova Scotia. The fall webworm attracts much attention during August,

forming large webs over the limbs on which it feeds, and is frequently mistaken for the tent caterpillar (American), which forms a somewhat similar web two months earlier in the season.

The Fall Webworm is very thoroughly controlled by parasites, infestations running for three or four years until the parasites become numerous, when they are practically exterminated for a number of years. They begin feeding on the apple a little too late to be influenced by the regular sprays, and the most economical method of controlling them would be to pick the clusters of larvae from the trees and destroy them, as soon as the webs are noticed.

The Apple-Leaf Sewer.

This insect, *Ancyclus nubiculana*, is found in small numbers in most orchards in Nova Scotia. The method of attack of this insect is peculiar. The leaf is folded along the midrib, the outer surfaces being brought together and the edges sewed with a fine white webbing. The larva feeds during the fall in this case or purse, and when the leaf falls to the ground it hibernates as a full grown larva in this leaf or case. Occasionally, outbreaks are found in which over half of the leaves in an orchard are sewed together by this insect. The most serious injury seems to be the causing of premature dropping of the leaves, which invariably causes a short bloom and crop the following year. Late fall or early spring plowing, to bury the hibernating larvae in the leaves, or thorough spraying with a very adhesive arsenical in the last two regular summer sprays, are the best means of control.

The Dock Sawfly.

The Dock Sawfly, *Taxonus nigrisoma*, has been found in some districts doing considerable damage to the fruit of the apple. In one orchard near Middleton, one-third of the Baldwins were found to contain the hibernating larvae of this insect. In some apples as many as five larvae were found. The larvae, greenish in color with black heads, do not feed on the apple but bore into the fruit, simply to find convenient hibernating quarters. A small hole is bored through the skin, and a hibernating chamber scooped out immediately beneath the skin. The food plants are the two docks, the curled and broadleaved. There are three broods a year in Nova Scotia. The remedy is to destroy all Dock growing in the orchard. In cases where it was not practical to remove the dock and the orchard becomes

infested, tanglefoot applied to the trees, as for canker worm, in September, would prevent the larvae from ascending the trees and so damaging the apples.

The Shot Hole Borer.

The Shot Hole Borer, *Xyleborus pyri*, is found occasionally damaging trees that have been weakened from some other cause such as canker work stripping, or unfavorable soil conditions. Occasionally ten or twelve year old trees are found with hundreds of small holes in them. Such trees when too seriously infested should be destroyed. When the vigor of the tree is still moderate to good, treatment can be applied with good chances of saving the tree and controlling the insects.

Plugging the hole by driving in small wooden plugs and nails have proven successful in many cases, while experiments with carbon bisulphide injected into the holes with a spring bottom oil can, the holes being immediately plugged with clay or putty, have shown that all the insects in the tunnel may be killed in this manner. In case a tree is very badly infected a dressing of nitrate of soda or some such quick acting fertilizer accompanying the above treatments will often save trees that would otherwise succumb.

The Round Head Apple Tree Borer.

This borer, *Saperda candida*, occasionally injures the apple in Nova Scotia. Usually young trees are attacked. The eggs are laid on the bark in June and July. The larva feeds on the trunk of the tree for three years, at first in the sapwood, but later near the heart. Where the tunnels can be located by the discolored bark, a spike or punch should be driven in and a small quantity of carbon bisulphide injected from a spring bottom oil can and the hole plugged with clay or putty at once.

The Brown-Tail Moth.

This insect of European origin, which has been brought to Nova Scotia via the United States, has not as yet done a single dollar's worth of damage in the Province, but it has in it the possibility of becoming as serious, and doing as much damage, as any, or perhaps all of the insects that we have considered.

History.

The Brown-tail Moth was introduced into Massachusetts from Europe some time prior to its discovery in 1897, presumably on nursery stock. In 1907 the first nest was discovered in Nova Scotia by Mr. Perry Foote in Lakeville, Kings County. The infestation at that time extended from Lakeville, Kings Co., to Deerfield, Yarmouth Co.

The following table shows the number of nests taken each winter since its discovery:

1906-07.....	6,000 approximate
1907-08.....	4,000 "
1908-09.....	800 "
1909-10.....	1,496 "
1909-10.....	1,496 actual count
1910-11.....	4,362 "
1911-12.....	7,707 "
1912-13.....	11,054 "
1913-14.....	24,156 "
1914-15.....	18,154 "
1915-16.....	14,755 "

The area infested at the present time is approximately the same as in 1907, the year of discovery. The infestation extends a little farther east in the Valley, including a portion of Hants Co., otherwise it remains the same in distribution. Shelburne and Cumberland Counties were infested in 1913 by the big flight from the New England States. Since 1913 the Brown-tail Moth has been exterminated from both of these counties and the total number in the Province cut down to two-thirds of that of 1913-14.

Description and Life History.

The adult Browntail is a snowy white moth about 1½ inches across the expanded wings. Both sexes have a characteristic tuft of brown hairs at the tip of the body from which they get their name, Browntail. Both sexes are strong fliers and are frequently carried long distances by the wind, the Counties of Yarmouth and Shelburne having been infested in 1913 by female moths which blew across the Bay of fundy from infestations along the New England coast. In ordinary years a moderate flight of male moths is found at Yarmouth, but as very few nests are found after these flights have occurred, we know that it is the exception for female moths to cross the Bay of Fundy from the New England coast.

The eggs are deposited on the under side of the leaves in late July or early August. The egg cluster contains about 300 eggs deposited in an irregular mass about one quarter of an inch wide and one half an inch long, and is covered with brown hairs from the tuft at the tip of the body of the female which adhere to the egg mass as the eggs are deposited.

In about three weeks the eggs hatch and the young larvae feed on the leaves within six inches of the egg mass, nibbling at the surface and reducing the leaf to a skeleton. As the season progresses one or more leaves are tied together with silk to form the winter nest. About Oct. 15th, this nest is well formed and dirty yellow in color, later bleaching out with the rain and sun to the characteristic grey white winter nest. On dry sunny days during the winter, these nests reflect the sun and appear a conspicuous bright white for a long distance; when dampened by fog or rain the white color disappears and the nest becomes a dirty grey, about the color of the bark of the tree and is very hard to see. The winter nests contain on an average, in Nova Scotia, about 250 caterpillars. These emerge when the first leaves appear in the spring, usually about May 1st. When they first emerge from the nest, the larvae are strongly positively heliotropic, climbing to the top of the branches and there feeding on the young leaves. In about two weeks the positive heliotropism disappears and the larvae scatter over the trees, feeding singly, and maturing about the first week in July. The full grown larvae are from 1 to 1½ inches in length, brown, very hairy, and with lateral rows of white spots on the abdominal segments, and a tuft of orange colored hairs on the dorsal side of both the 6th and 7th abdominal segments.

The pupa is formed either singly or with few others in one or more curled up leaves, the leaf being loosely drawn together into a very open cocoon of brown silk. The pupa is from ½ to 7-12 inches in length and brown in color. The pupal stage lasts about three weeks.

Food Plants.

The major food plant in Nova Scotia has always been the apple. The following table shows the percentages of nests formed on apple in Nova Scotia during the past four years:

1912-13.....	88.2 per cent
1913-14.....	86.1 "
1914-15.....	85.4 "
1915-16.....	74.3 "

Although the percentage on native trees is increasing as the years go on, there seems to be no immediate danger of the Browntail becoming a woodland pest in the province.

Control.

The Browntail Moth is now controlled by parties of inspectors, one half of whom are paid by the Provincial Department of Agriculture and one half by the Dominion Entomological Branch. These men work under the direction of a Dominion Field Officer who, under the Dominion Entomologist, is responsible for the carrying on of the work.

At the present time, ten inspectors are employed who, during the six months between November 1st and May 1st, cover all of Yarmouth, Digby, Annapolis, Kings and Hants counties, and scout the adjoining counties.

It was noticed today in the history of the infestation, that it was much easier to control the Brown-tails in the districts where a high percentage of the orchards were sprayed, than where spraying was not practiced. A campaign for more and better spraying was then instituted, the inspectors given suitable literature and instructed to call on every owner whose property was infested to persuade him to spray if possible. The co-operation and help of the Dominion Fruit Inspectors, under Chief Inspector G. H. Vroom has been felt and appreciated, as has been the assistance of the officials and managers of the United Fruit Companies. The result of the thorough campaign for more and better spraying, carried on by these three organizations, some member of each being in direct touch with every fruit-grower in the province, has not only aided materially in controlling the browntail moth, but has also to its credit, the fact that it has been instrumental in causing Nova Scotia to have the cleanest crop of apples grown in Canada in 1916, a season most favorable to the development of scab and other diseases.

The best evidence of the extreme success of this campaign may be obtained by comparing the number of power sprayers sold year by year in Nova Scotia. One of the largest companies selling sprayers has placed the following:

1912.....	48	sprayers
1913.....	99	"
1914.....	153	"
1915.....	189	"
1916.....	238	"

When we remember that in 1916 the general opinion was that prices would be low in 1916-17 and also that this particular company ran out of power outfits and had to stop selling before the season was over, we can get a fair idea of the success of the fruit inspectors, the fruit company men, and the Browntail moth inspectors in convincing people as to the value of spraying.

The success of this spraying campaign which appears not yet to have reached its highest, will probably render the control of the Browntail an easy matter in the apple producing districts, but outlying orchards, small holdings and town properties, will have to be looked after for many years yet.

Parasites.

During the past three years the Dominion Entomological Branch has introduced the European predaceous climbing ground beetle, *Calosoma sycophanta*, partly to prey on the Browntail moths and partly in advance of the Gypsy moth which will come sooner or later, and two true parasites, a tachinid, *Compsilura consinnata*, and a Braconid, *Apanteles lacteicolor*, and one fungus disease, *Entomophthora ulicae*. Of these parasites only the *Apanteles* has been recovered. With the equipping of the new laboratory at Annapolis, the introduction, increase and spread of the parasites of the Browntail will increase, but we cannot look for quick spectacular results from this parasite work. At best it will be very slow work getting the parasites established so that they will be real factors in the control of the Browntail, although we realize that it is the only means of permanent control and we are making every effort to get the parasites established.

Spraying for the Various Insects.

The spray calendar prepared by Prof. W. H. Brittain, Provincial Entomologist, and the writer, gives a complete summary of controls of all biting insects mentioned in this article and for that reason detailed information as to controls has been omitted, and the reader is referred to the spray calendar for the best and most economical method of spraying to control the pests mentioned herein.